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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/689,423	Applicant(s) JENNER ET AL.	
	Examiner Scott A Hughes	Art Unit 3663	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-67* is/are pending in the application.

4a) Of the above claim(s) *19-23* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-18 and 24-67* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _____ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-18 and 24-67, drawn to methods of processing seismic data involving estimating a time shift and performing amplitude correction and other corrections, classified in class 367, subclass 50.

II. Claims 19-23, drawn to methods of processing seismic data according to time shifts with an emphasis of selection of time windows, classified in class 367, subclass 50.

The inventions are distinct, each from the other because of the following reasons:

This application contains claims directed to the following patentably distinct species of the claimed invention: Group I and Group II.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable.

Applicant is advised that a reply to this requirement must include an identification of the species that is elected consonant with this requirement, and a listing of all claims readable thereon, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which are written in dependent form or otherwise include all the limitations of an allowed generic claim as provided by 37 CFR 1.141. If claims are added after the election, applicant must indicate which are readable upon the elected species. MPEP § 809.02(a).

Should applicant traverse on the ground that the species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention.

During a telephone conversation with David Walker on 9/20/2004 a provisional election was made with traverse to prosecute the invention of Group I, claims 1-18 and 24-67. Affirmation of this election must be made by applicant in replying to this Office action. Claims 19-23 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 112

Claim 44 is rejected under 35 U.S.C 112 Fourth Paragraph. U.S.C.112 Fourth Paragraph states:

> Subject to the following paragraph, a claim in dependent form shall contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.

Claim 44 is dependent upon claim 43, but it does not further limit the subject matter claimed. Claim 44 has the limitation of utilizing the estimated time shift comprising a least squares analysis process. Claim 43 also contains this same limitation – "applying a least squares analysis process to the time shift of said seismic data traces." It is unclear as to how claim 43 further limits the process of claim 44.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 2, 33-36, 39-40, 46-49, 52-53, and 59-62 are rejected under 35 U.S.C. 102(b) as being anticipated by Ruehle.

With regard to claim 1, Ruehle discloses a method for processing seismic data to estimate a time shift comprising forming a gather of seismic data traces (Column 2, Lines 5-9). He discloses cross-correlating seismic data traces included in the gather within a time window to estimate a time shift in the seismic data traces (Column 2, Lines 14-23).

With regard to claim 2, Ruehle discloses adjusting seismic data traces in a gather by the amount of the estimated time shift (Column 2, Lines 20-26).

With regard to claim 33, Ruehle discloses estimating a time shift in seismic data traces comprising cross-correlating seismic data traces with a pilot trace comprised from a plurality of traces included in a gather (abstract; Column 2, Lines 8-25).

With regard to claim 34, Ruehle discloses a method for forming a pilot trace comprising compositing a plurality of traces within a predetermined spatial time window within a gather of seismic traces (Column 2, Lines 5-25).

With regard to claim 35, Ruehle discloses using the estimated time shift in the seismic data traces for determining a time shift correction for the seismic data traces (Column 2, Lines 15-21). Ruehle's disclosure of determining the static time shifts for each trace by the estimation method of cross correlation is read as estimating the time shift for each trace.

With regard to claim 36, Ruehle discloses applying the time shift correction to the seismic traces (Column 2, Lines 20-25) to form corrected seismic traces.

With regard to claim 39, Ruehle discloses determining a surface consistent statics correction for seismic data traces (Column 1, lines 39-46 and Column 2, Lines 20-26).

With regard to claim 40, Ruehle discloses a digital computer programmed to utilize seismic data traces obtained over a region of the earth's subsurface to perform a process comprising forming a gather of seismic traces, and cross-correlating seismic

data traces included in a gather within a time window to estimate a time shift in the seismic data traces (Columns 5-6).

With regard to claim 46, Ruehle discloses the digital computer wherein the process for estimating the time shift further comprises cross-correlating the seismic data traces with a pilot trace composited from a plurality of traces (Column 2, lines 15-25).

With regard to claim 47, Ruehle discloses the pilot trace further comprising a plurality of traces composited from within a predetermined time window within a gather of traces (Column 2, Lines 10-25).

With regard to claim 48, Ruehle discloses the digital computer of claim 40 further programmed to perform using the estimated time shift in the seismic data traces for determining a time shift correction for the seismic data traces (Column 2, Lines 15-21). Ruehle's disclosure of determining the static time shifts for each trace by the estimation method of cross correlation is read as estimating the time shift for each trace.

With regard to claim 49, Ruehle discloses a computer further programmed to perform a process comprising applying the time shift correction to the seismic traces (Column 2, Lines 20-25) to form corrected seismic traces.

With regard to claim 52, Ruehle discloses determining a surface consistent statics correction for seismic data traces (Column 1, lines 39-46 and Column 2, Lines 20-26).

With regard to claim 53, Ruehle discloses a system for processing seismic data to estimate a time shift comprising forming a gather of seismic data traces (Column 2, Lines 5-9). He discloses cross-correlating seismic data traces included in the gather

within a time window to estimate a time shift in the seismic data traces (Column 2, Lines 14-23).

With regard to claim 59, Ruehle discloses the system wherein the process for estimating the time shift further comprises cross-correlating the seismic data traces with a pilot trace composited from a plurality of traces (Column 2, lines 15-25).

With regard to claim 60, Ruehle discloses the pilot trace further comprising a plurality of traces composited from within a predetermined time window within a gather of traces (Column 2, Lines 10-25).

With regard to claim 61, Ruehle discloses the system of claim 53 further using the estimated time shift in the seismic data traces for determining a time shift correction for the seismic data traces (Column 2, Lines 15-21). Ruehle's disclosure of determining the static time shifts for each trace by the estimation method of cross correlation is read as estimating the time shift for each trace.

With regard to claim 62, Ruehle discloses a system comprising applying the time shift correction to the seismic traces (Column 2, Lines 20-25) to form corrected seismic traces.

Claims 8-12 and 24-26 are rejected under 35 U.S.C. 102(b) as being anticipated by Thompson et al..

Referring to claim 8, Thompson et al. discloses a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface, comprising: forming a gather of seismic data traces; forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 21, lines 35-36); and cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 4, lines 22-32; col. 21, lines 40-42; figures 6 and 10-11).

As to claim 9, Thompson et al. discloses a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface, comprising: (a) forming a gather of seismic data traces; (b) forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 21, lines 35-36); (c) cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 4, lines 22-32; col. 21, lines 40-42; figures 6 and 10-11); and repeating steps (b) and (c) until all seismic data traces within the gather have been cross-correlated with a pilot trace (figures 6 and 10-11).

Referring to claim 10, Thompson et al. discloses a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface, comprising: (a)

forming a gather of seismic data traces; (b) forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 21, lines 35-36); (c) cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 4, lines 22-32; col. 21, lines 40-42; figures 6 and 10-11); repeating steps (b) and (c) until all seismic data traces within the gather have been cross-correlated with a pilot trace (figures 6 and 10-11); and adjusting each selected seismic data trace by the amount of the estimated time shift in each selected seismic data trace resulting from velocity anisotropy (col. 28, lines 1-3; figures 6 and 10-11).

As to claims 11-12, Thompson et al. discloses a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface further comprising performing an amplitude variation with incidence angle and azimuth analysis on the adjusted seismic data traces (col. 2, lines 47-67 and col. 3, lines 1-3).

Referring to claim 24, Thompson et al. discloses a digital computer programmed to utilize seismic data traces obtained over a region of the earth's subsurface to perform a process comprising the steps of : forming a gather of seismic data traces; forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 23, lines 26-30); and cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data traces resulting from the velocity anisotropy in the earth's subsurface (col. 23, lines 34-36).

As to claim 25, Thompson et al. discloses a device which is readable by a digital computer having instructions defining the following process and instructions to the computer to

perform the process: forming a gather of seismic data traces; forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 25, lines 27-31); and cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 25, lines 35-37).

Referring to claim 26, Thompson et al. discloses a device which is readable by a digital computer having instructions defining the following process and instructions to the computer to perform the process wherein the device is selected from the group consisting of a magnetic tape, a magnetic disk, an optical disk, and a CD-ROM (col. 23, lines 24-25).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 3, 29, 30, 37, 43, 51, 56, and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ruehle in view of Crider.

With regard to claim 3, Ruehle discloses adjusting seismic data traces by an amount estimated from a determined time shift. Ruehle does not disclose performing an amplitude variation with incidence angle analysis on the adjusted seismic traces. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data.

With regard to claim 29, Ruehle does not disclose utilizing the estimated time shift to calculate the amplitude variation with incidence angle in seismic data traces. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data.

With regard to claim 30, Ruehle does not disclose using a least squares analysis process to utilize the estimated time shift to calculate an amplitude variation with incidence angle. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). Crider further discloses applying a least squares analysis process to reflection coefficient (amplitude) and to angle of incidence (Column 10, Lines 33-60). It would have been obvious to modify Ruehle to include performing a least squares analysis process on amplitude variation with incidence angle data as taught by Crider in order to obtain best fit values for the data.

With regard to claim 37, Ruehle does not disclose performing an amplitude variation with incidence angle analysis on the adjusted seismic traces. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data.

With regard to claim 43, Ruehle discloses the computer of claim 40, but does not disclose applying a least squares analysis process to the time shift of the seismic data traces to calculate an amplitude variation with incidence angle value. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation

based on incidence angle as taught by Crider in order to remove unwanted reflections from the data. Crider further discloses applying a least squares analysis process to reflection coefficient (amplitude) and to angle of incidence (Column 10, Lines 33-60). It would have been obvious to modify Ruehle to include performing a least squares analysis process with the estimated time shifts used to calculate amplitude variation with incidence angle data as taught by Crider in order to obtain best fit values for the data with the computer.

With regard to claim 51, Ruehle discloses the digital computer of claim 49, but does not disclose further programming it to perform an amplitude variation with incidence angle analysis on the adjusted seismic traces. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data.

With regards to claims 56 and 57, Ruehle discloses the system of claim 53, but does not disclose utilizing the time shift of the data traces to calculate the amplitude variation with incidence angle. He also does not disclose utilizing the estimated time shift comprising a least squares analysis process. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on

incidence angle as taught by Crider in order to remove unwanted reflections from the data. Crider further discloses applying a least squares analysis process to reflection coefficient (amplitude) and to angle of incidence (Column 10, Lines 33-60). It would have been obvious to modify Ruehle to include performing a least squares analysis process with the estimated time shifts used to calculate amplitude variation with incidence angle data as taught by Crider in order to obtain best fit values for the data with the computer.

Claims 3, 29, 37, and 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ruehle in view of Herkenhoff.

With regard to claim 3, Ruehle discloses adjusting seismic data traces by an amount estimated from a determined time shift. Ruehle does not disclose performing an amplitude variation with incidence angle analysis on the adjusted seismic traces. Herkenhoff discloses performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3,4,7,8). It would have been obvious to modify Ruehle to include performing amplitude variation based on incidence angle as taught by Herkenhoff in order to easily follow changes in amplitude that would allow determination of characteristics of a hydrocarbon well.

With regard to claim 29, Ruehle discloses adjusting seismic data traces by an amount estimated from a determined time shift. Ruehle does not disclose performing an amplitude variation with incidence angle analysis on the adjusted seismic traces. Herkenhoff discloses performing an amplitude variation with incidence angle analysis on

adjusted seismic data traces (Fig. 3,4,7,8). It would have been obvious to modify the utilization of the estimated time shifts disclosed by rule Ruehle to include performing amplitude variation based on incidence angle as taught by Herkenhoff in order to easily follow changes in amplitude that would allow determination of characteristics of a hydrocarbon well.

With regard to claim 37, Ruehle discloses adjusting seismic data traces by an amount estimated from a determined time shift. Ruehle does not disclose performing an amplitude variation with incidence angle analysis on the adjusted seismic traces. Herkenhoff discloses performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3,4,7,8). It would have been obvious to modify Ruehle to include performing amplitude variation based on incidence angle as taught by Herkenhoff in order to easily follow changes in amplitude that would allow determination of characteristics of a hydrocarbon well.

With regard to claim 51, Ruehle discloses the digital computer of claim 49, but does not disclose further programming it to perform an amplitude variation with incidence angle analysis on the adjusted seismic traces. Herkenhoff discloses performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3,4,7,8). It would have been obvious to modify Ruehle to include performing amplitude variation based on incidence angle as taught by Herkenhoff in order to easily follow changes in amplitude that would allow determination of characteristics of a hydrocarbon well.

Claims 4, 27, 31, 38, 41, 45, 50, 54, and 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ruehle in view of Ruger.

With regard to claim 4, Ruehle does not disclose performing an amplitude variation with azimuth analysis on adjusted seismic data traces. "Variation of P-wave reflectivity with offset and azimuth in anisotropic media" by Ruger discloses performing amplitude variation with azimuthal analysis on adjusted seismic data. It would have been obvious to modify the time shifted traces of Ruehle to include performing amplitude variation with azimuth analysis as taught by Ruger in order to gain information relating amplitude to the coordinate system of the underground formations.

With regard to claim 27, Ruehle does not disclose utilizing the estimated time shift of the seismic data traces to calculate an amplitude variation or a velocity variation with azimuth value. Ruger discloses variation of P-wave reflectivity with offset and azimuth that deals with amplitude variation. It would have been obvious to modify Ruehle to utilize the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth as taught by Ruger in order to check the accuracy of the data taken for a certain underground structure.

With regard to claim 31, Ruehle does not disclose utilizing the estimated time shift, reflection coefficient, source-receiver azimuth angle, and incidence angle for the seismic data traces to calculate an amplitude variation with azimuth. Ruger discloses utilizing reflection coefficient, source-receiver azimuth angle, and incidence angle for the seismic data traces to calculate an amplitude variation with azimuth (Abstract, page 939). It would have been obvious to modify Ruehle to include utilizing the estimated

time shift and reflection coefficients to include utilizing the source-receiver azimuth angle as taught by Ruger to calculate an amplitude variation with azimuthal angle in order to help find the orientation of the natural coordinate system of the subsurface (Ruger, page 940).

With regard to claim 38, Ruehle does not disclose performing an amplitude variation with azimuth analysis or a velocity variation with azimuth analysis on the corrected seismic traces. Ruger discloses performing amplitude variation with azimuthal analysis on adjusted seismic data. It would have been obvious to modify the time shifted traces of Ruehle to include performing amplitude variation with azimuth analysis as taught by Ruger in order to gain information relating amplitude to the coordinate system of the underground formations.

With regard to claim 41, Ruehle discloses the digital computer of claim 40, but does not disclose programming it to perform a process comprising utilizing the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth value or a velocity variation with azimuth value in the seismic traces. Ruger discloses analyzing the reflection coefficient as a function of azimuth (page 939). Since the reflection coefficient is directly related to the amplitude, this is read as calculating the amplitude variation with azimuth. It would have been obvious to modify the digital computer system of Ruehle to include utilizing the estimated time shift to calculate an amplitude variation with azimuth as taught by Ruger in order to have the computer program give information about the natural coordinate system of the underground formation (Ruger, page 940).

With regard to claim 45, Ruehle discloses the digital computer of claim 40, but does not disclose utilizing the estimated time shift, reflection coefficient, source-receiver azimuth angle, and incidence angle for the seismic data traces to calculate an amplitude variation with azimuth. Ruger discloses utilizing reflection coefficient, source-receiver azimuth angle, and incidence angle for the seismic data traces to calculate an amplitude variation with azimuth (Abstract, page 939). It would have been obvious to modify Ruehle to include utilizing the estimated time shift and reflection coefficients to include utilizing the source-receiver azimuth angle as taught by Ruger to calculate an amplitude variation with azimuthal angle in order to help find the orientation of the natural coordinate system of the subsurface (Ruger, page 940).

With regard to claim 50, Ruehle discloses the computer of claim 49, but does not disclose that it is further programmed to perform a process utilizing the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth or a velocity variation with azimuth value. Ruger discloses variation of P-wave reflectivity with offset and azimuth that deals with amplitude variation. It would have been obvious to modify Ruehle to utilize the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth as taught by Ruger in order to check the accuracy of the data taken for a certain underground structure.

With regard to claim 54, Ruehle discloses the system of claim 53, but does not disclose utilizing the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth or a velocity variation with azimuth value. Ruger discloses variation of P-wave reflectivity with offset and azimuth that deals with

amplitude variation. It would have been obvious to modify Ruehle to utilize the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth as taught by Ruger in order to check the accuracy of the data taken for a certain underground structure.

With regard to claim 58, Ruehle discloses the system of claim 53, but does not disclose utilizing the estimated time shift, reflection coefficient, source-receiver azimuth angle, and incidence angle for the seismic data traces to calculate an amplitude variation with azimuth. Ruger discloses utilizing reflection coefficient, source-receiver azimuth angle, and incidence angle for the seismic data traces to calculate an amplitude variation with azimuth (Abstract, page 939). It would have been obvious to modify Ruehle to include utilizing the estimated time shift and reflection coefficients to include utilizing the source-receiver azimuth angle as taught by Ruger to calculate an amplitude variation with azimuthal angle in order to help find the orientation of the natural coordinate system of the subsurface (Ruger, page 940).

Claims 5, 28, 32, 42, 55, and 63-67 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ruehle in view of Crider and Ruger, or Ruehle in view of Herkenhoff and Ruger.

With regard to claim 5, Ruehle discloses the method of claim 2, but does not disclose determining the incidence angle for seismic data traces. He does not disclose calculating the amplitude variation with azimuth or the amplitude variation with offset by

applying a least squares analysis process to the reflection coefficient, source-receiver azimuth angle, and incidence angle for seismic data traces. Crider and Herkenhoff disclose determining the incidence angle and calculating amplitude variation with offset and with incidence angle as described in claim 3 above. Ruger discloses performing amplitude variation analysis with respect to azimuthal angle (4). Crider discloses applying a least squares analysis process to reflection coefficient and to angle of incidence (Column 10, Lines 33-60). Herkenhoff also discloses applying a least squares analysis process to reflection coefficient and incidence angle for data traces (Column 3, lines 52-65). It would have been obvious to apply the same least squares analysis to the azimuth angle in the amplitude variation with azimuth taught by Ruger in order to generate best fits of the seismic data traces.

With regard to claim 28, Ruehle and Ruger do not disclose utilizing the time shifts further comprising a least squares process analysis. Both Crider and Herkenhoff disclose performing least squares process analysis on seismic trace data. It would have been obvious to modify Ruehle and Ruger to include performing a least squares process on the data as taught by Crider and Herkenhoff in order to obtain best fit values for specific parameters, including azimuthal angle, amplitude, and reflection coefficient.

With regard to claim 32, Ruehle does not disclose determining the incidence angle for the traces in the gather. He does not disclose calculating the amplitude variation with azimuth or the amplitude variation with offset by applying a least squares analysis process to the reflection coefficient, source-receiver azimuth angle, and incidence angle for seismic data traces. Crider and Herkenhoff disclose determining the

incidence angle and calculating amplitude variation with offset and with incidence angle as described in claim 3 above. It would have been obvious to modify Ruehle to include determining the incidence angle for the traces as taught by Crider and Herkenhoff. Ruger discloses performing amplitude variation analysis with respect to azimuthal angle (paragraph 4). Crider discloses applying a least squares analysis process to reflection coefficient and to angle of incidence (Column 10, Lines 33-60). Herkenhoff also discloses applying a least squares analysis process to reflection coefficient and incidence angle for data traces (Column 3, lines 52-65). It would have been obvious to modify Ruehle to apply the same least squares analysis to the azimuth angle in the amplitude variation with azimuth taught by Ruger in order to generate best fits of the seismic data traces.

With regard to claim 42, Ruehle and Ruger disclose the computer program of claim 41, but do not disclose a least squares analysis process for utilizing the estimated time shifts to calculate an amplitude variation with azimuth. Crider discloses applying a least squares analysis process to reflection coefficient and to angle of incidence (Column 10, Lines 33-60). Herkenhoff also discloses applying a least squares analysis process to reflection coefficient and incidence angle for data traces (Column 3, lines 52-65). It would have been obvious to modify Ruehle to apply the same least squares analysis to the azimuth angle in the amplitude variation with azimuth taught by Ruger in order to generate best fits of the seismic data traces.

With regard to claim 55, Ruehle and Ruger disclose the system of claim 54, but do not disclose a least squares analysis process for utilizing the estimated time shifts to

calculate an amplitude variation with azimuth. Crider discloses applying a least squares analysis process to reflection coefficient and to angle of incidence (Column 10, Lines 33-60). Herkenhoff also discloses applying a least squares analysis process to reflection coefficient and incidence angle for data traces (Column 3, lines 52-65). It would have been obvious to modify Ruehle to apply the same least squares analysis to the azimuth angle in the amplitude variation with azimuth taught by Ruger in order to generate best fits of the seismic data traces.

With regard to claim 63, Ruehle discloses a method for processing seismic data to estimate a time shift comprising forming a gather of seismic data traces (Column 2, Lines 5-9). He discloses cross-correlating seismic data traces included in the gather within a time window to estimate a time shift in the seismic data traces (Column 2, Lines 14-23). He does not disclose utilizing the estimated time shift of the seismic data traces to calculate an amplitude variation with incidence angle, an amplitude variation with azimuth or a velocity variation with azimuth value. Ruger discloses variation of P-wave reflectivity with offset and azimuth that deals with amplitude variation. It would have been obvious to modify Ruehle to utilize the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth as taught by Ruger in order to check the accuracy of the data taken for a certain underground structure. Herkenhoff discloses performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3,4,7,8). It would have been obvious to modify Ruehle to include performing amplitude variation based on incidence angle as taught by Herkenhoff in order to easily follow changes in amplitude that would allow determination

of characteristics of a hydrocarbon well. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data.

With regard to claim 59, Ruehle discloses the system wherein the process for estimating the time shift further comprises cross-correlating the seismic data traces with a pilot trace composited from a plurality of traces (Column 2, lines 15-25).

With regard to claim 64, Ruehle discloses estimating a time shift in seismic data traces comprising cross-correlating seismic data traces with a pilot trace comprised from a plurality of traces included in a gather (abstract; Column 2, Lines 8-25). Ruehle discloses a method for forming a pilot trace comprising compositing a plurality of traces within a predetermined spatial time window within a gather of seismic traces (Column 2, Lines 5-25).

With regard to claim 65, Ruehle discloses using the estimated time shift in the seismic data traces for determining an anisotropy time shift correction for the seismic data traces (Column 2, Lines 15-21). Ruehle's disclosure of determining the static time shifts for each trace by the estimation method of cross correlation is read as estimating the time shift for each trace.

With regard to claim 66, Ruehle discloses applying the anisotropy time shift correction to the seismic traces (Column 2, Lines 20-25) to form corrected seismic traces.

With regard to claim 67, Ruehle discloses determining a surface consistent statics correction for seismic data traces (Column 1, lines 39-46 and Column 2, Lines 20-26).

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ruehle in view of Byun.

With regard to claim 6, Ruehle does not disclose applying a least squares analysis process to the time shift of the seismic data traces. Byun discloses performing a least squares best-fit analysis of the time shifts (Column 7 Line 51 – Column 8 Line 4). It would have been obvious to modify Ruehle to include a best fit analysis of the time shift values as taught by Byun in order to optimize the accuracy of the correction of velocity functions for the traces.

Claims 7 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ruehle in view of Crider and Byun.

With regard to claim 17 and 18, Ruehle discloses forming a gather of seismic traces and forming a pilot trace by combining a selected plurality of seismic traces within a time window (Column 2, Lines 1-20). Ruehle discloses determining a surface consistent statics correction for seismic data traces (Column 1, lines 39-46 and Column 2, Lines 20-26). Ruehle discloses cross-correlating successive selected seismic data traces in the gather to estimate a time shift in the seismic data traces included in the gather (Abstract). He does not disclose applying a least squares analysis process to

the time shifts of the seismic data traces to calculate velocity variation with azimuth. Ruehle does disclose calculating time shifts in the seismic data traces and applying the time shifts to the data traces (Column 2, Lines 15-25). Ruehle does not disclose applying a least squares analysis process to reflection coefficient, source-receiver azimuth, and incidence angle data for the seismic traces. Byun discloses performing a least squares best-fit analysis of the time shifts (Column 7 Line 51 – Column 8 Line 4). It would have been obvious to modify Ruehle to include a best fit analysis of the time shift values as taught by Byun in order to optimize the accuracy of the correction of velocity functions for the traces. Crider discloses applying a least squares analysis process to reflection coefficient and to incidence angle data. Although Crider does not disclose performing a least squares analysis process to source-receiver azimuth, it would have been obvious to include source-receiver azimuth in the least squares analysis taught by Crider if that were one of the parameters of interest. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data. Crider further discloses applying a least squares analysis process to reflection coefficient (amplitude) and to angle of incidence (Column 10, Lines 33-60). It would have been obvious to modify Ruehle to include performing a least squares analysis process with the estimated time shifts used to calculate amplitude variation

with incidence angle data as taught by Crider in order to obtain best fit values for the data.

Claims 13 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Thompson et al. in view of Herkenhoff et al. and further in view of "Variation of P-Wave Reflectivity with Offset and Azimuth in Anisotropic Media", Ruger (Referred hereafter as Ruger).

Referring to claim 13, Thompson et al. discloses a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface, comprising: (a) forming a gather of seismic data traces; (b) forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 21, lines 35-36); (c)

cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 4, lines 22-32; col. 21, lines 40-42; figures 6 and 10-11); repeating steps (b) and (c) until all seismic data traces within the gather have been cross-correlated with a pilot trace (figures 6 and 10-11); and adjusting each selected seismic data trace by the amount of the estimated time shift in each selected seismic data trace resulting from velocity anisotropy (col. 28, lines 1-3; figures 6 and 10-11).

Thompson et al. does not disclose a method for processing seismic data, comprising determining the incidence angle for each selected data trace and applying a least squares analysis process to reflection coefficient, source-receiver azimuth angle and incidence angle data of the seismic data traces to calculate the amplitude variation with azimuth and amplitude variation with offset in seismic data traces included in the gather.

Herkenhoff et al. discloses a method for processing seismic data, comprising determining the incidence angle for each selected seismic data traces (figures 2-4); and applying a least squares analysis process to reflection coefficient and incidence angle data of the seismic data traces to calculate the amplitude variation with offset in seismic data traces included in the gather (col. 3, lines 37-65; figures 7-8 and 10A-10B).

Herkenhoff et al. does not disclose a method for processing seismic data, comprising applying a least squares analysis process to reflection coefficient and source-receiver azimuth angle to calculate the amplitude variation with azimuth in seismic data traces included in the gather.

Ruger discloses a method for processing seismic data, comprising applying a least squares analysis process to reflection coefficient, source-receiver azimuth angle and incidence angle data of the seismic data traces to calculate the amplitude variation with azimuth in seismic data traces included in the gather (page 937, equations 1, 2, and 5; figures 1, 2, and 3 on pages 937-939).

Accordingly, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have applied the least squares analysis process to reflection coefficient, source-receiver azimuth angle and incidence angle data of the seismic traces to calculate the amplitude variation with azimuth as described in the Ruger reference and the amplitude variation with offset as described in the Herkenhoff et al. reference in seismic data traces included in the gather into the method of Thompson et al. to improve locating the positions of the reflecting interfaces indicative of potential oil reservoirs or other geological phenomenon of interest.

As to claim 15, Thompson et al./Herkenhoff et al./Ruger do not disclose a method for processing seismic data comprising utilizing a least squares analysis to estimate errors associated with the calculation of amplitude variation in the selected seismic data traces.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have utilized a least squares analysis to estimate errors associated with the calculation of amplitude variation in the selected seismic data traces for having a more accurate approximation in calculating the amplitude variation to eliminate the numbers of calculations to cut cost and save time.

Claims 14 and 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Thompson et al. in view of Byun et al..

Referring to claim 14, Thompson et al. discloses a method for processing seismic data, comprising: (a) forming a gather of seismic data traces; (b) forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 21, lines 35-36); (c) cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 4, lines 22-32; col. 21, lines 40-42; figures 6 and 10-11); repeating steps (b) and (c) until all seismic data traces within the gather have been cross-correlated with a pilot trace (figures 6 and 10-11).

Thompson et al. does not disclose a method for processing seismic data comprising applying a least squares analysis process to the time shifts of the seismic data traces to calculate the velocity variation with azimuth in seismic data traces included in the gather.

Byun et al. discloses a method for processing seismic data comprising applying a least squares analysis process to the time shifts of the seismic data traces to calculate the velocity variation with azimuth in seismic data traces included in the gather (col. 7, lines 51-67; and col. 8, lines 1-4).

Accordingly, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have applied a least squares analysis process to the time shifts of the seismic data traces to calculate the velocity variation with azimuth in seismic data traces included in the gather as described in the Byun et al. reference into the method of Thompson et al. to improve estimating velocity and dip for each of the subsurface layers to identify gaseous

hydrocarbon containing formations and referring changes in the geological character of the formations in seismic exploration.

As to claims 16-17, Thompson et al./Byun et al. do not disclose a method for processing seismic data further comprising utilizing a least squares analysis to estimate errors associated with the calculation of time shift variation and velocity variation in the selected seismic data traces.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have utilized a least squares analysis to estimate errors associated with the calculation of time shift and velocity variations in the selected seismic data traces for having a more accurate approximation in calculating the velocity variation to eliminate the numbers of calculations to cut cost and save time.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Roche, who discloses a method correcting amplitude of seismic traces.

Bodine, who discloses a method of processing seismic data.

Gaiser, who discloses amplitude variation with azimuth methods.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Scott A Hughes whose telephone number is 703-305-0430. The examiner can normally be reached on 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Tarcza can be reached on 703-306-4171. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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